

What is claimed is:

- 1 1. An apparatus for detection of direct sequence
2 spread spectrum signals in networking systems, comprising:
3 a detection unit adapted to take a sample sequence from
4 a preamble of a newly arrived network packet,
5 comprising:
6 a first means for calculating a sequence of
7 correlation measures between said sample
8 sequence and a pseudo-noise code sequence of
9 length L , where L is a positive integer;
10 a second means for calculating an accumulation
11 sequence in which each accumulation value
12 thereof is obtained by summing N correlation
13 measures that are selected at an interval of
14 L from said sequence of correlation
15 measures, where N is a predetermined integer
16 number;
17 a third means for evaluating a statistic of said
18 sample sequence over a multiple of L number
19 of samples; and
20 a decision making unit for determining the presence of
21 direct sequence spread spectrum signals based on
22 a comparison between said statistic of said
23 sample sequence and a predetermined threshold
24 scaled by the maximum of said accumulation
25 sequence.
- 1 2. The apparatus as recited in claim 1 wherein said
2 accumulation sequence comprises L number of effective

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3 accumulation values and said second means calculates said
4 accumulation sequence, $\{A_m(N)\}$, from said correlation measure
5 sequence, $\{C(n)\}$, by the following equation:

6
$$A_m(N) = \sum_{k=0}^{N-1} C(m+k \cdot L), \quad m = 0, 1, 2, \dots, L-1$$

7 where n denotes a time instant, m denotes an integer index,
8 $C(n)$ denotes one of said correlation measures at time
9 instant n , and $A_m(N)$ denotes one of said accumulation values
10 at index m .

1 3. The apparatus as recited in claim 2 wherein said
2 decision making unit declares the presence of direct
3 sequence spread spectrum signals if the following condition
4 can hold true:

5
$$\frac{\max_m\{A_m(N)\}}{E_r(N)} > 1/\rho$$

6 where $\max_m\{A_m(N)\}$ denotes the maximum of said accumulation
7 sequence, $E_r(N)$ denotes said statistic of said sample
8 sequence, and ρ is said predetermined threshold.

1 4. The apparatus as recited in claim 2 wherein said
2 decision making unit declares the presence of direct
3 sequence spread spectrum signals if the following condition
4 can hold true:

5
$$\frac{\max_m\{A_m(N)\}}{E_r(N)} > 1/\rho, \quad N = N_1, N_1 + 1, \dots, N_2$$

6 where $N_2 > N_1$, N_1 and N_2 are positive integers, $\max_m\{A_m(N)\}$
7 denotes the maximum of said accumulation sequence, $E_r(N)$

8 denotes said statistic of said sample sequence, and ρ is
9 said predetermined threshold.

1 5. The apparatus as recited in claim 1 wherein said
2 third means evaluates said statistic over $(N-1)$ times L
3 number of samples of said sample sequence.

1 6. The apparatus as recited in claim 5 wherein said
2 statistic of said sample sequence, $E_r(N)$, is given by:

3
$$E_r(N) = \sum_{n=0}^{(N-1)L-1} |r(n)|^2$$

4 where n denotes a time instant and $r(n)$ denotes a sample of
5 said sample sequence $\{r(n)\}$ at time instant n .

1 7. The apparatus as recited in claim 5 wherein said
2 statistic of said sample sequence, $E_r(N)$, can be
3 approximated by the following equation:

4
$$E_r(N) = \sum_{n=0}^{(N-1)L-1} |r(n)|$$

5 where n denotes a time instant and $r(n)$ denotes a sample of
6 said sample sequence $\{r(n)\}$ at time instant n .

1 8. A method for detection of direct sequence spread
2 spectrum signals in networking systems, comprising the steps
3 of:

4 taking a sample sequence from a preamble of a newly
5 arrived network packet;
6 calculating a sequence of correlation measures between
7 said sample sequence and a pseudo-noise code
8 sequence of length L , where L is a positive
9 integer;

10 calculating an accumulation sequence in which each
11 accumulation value thereof is obtained by summing
12 N correlation measures that are selected at an
13 interval of L from said sequence of correlation
14 measures, where N is a predetermined integer
15 number;
16 evaluating a statistic of said sample sequence over a
17 multiple of L number of samples; and
18 determining the presence of direct sequence spread
19 spectrum signals based on a comparison between
20 said statistic of said sample sequence and a
21 predetermined threshold scaled by the maximum of
22 said accumulation sequence.

1 9. The method as recited in claim 8 wherein said
2 accumulation sequence, $\{A_m(N)\}$, comprises L number of
3 effective accumulation values and is calculated from said
4 sequence of correlation measures, $\{C(n)\}$, by the following
5 equation:

$$6 A_m(N) = \sum_{k=0}^{N-1} C(m+k \cdot L), \quad m = 0, 1, 2, \dots, L-1$$

7 where n denotes a time instant, m denotes an integer index,
8 $C(n)$ denotes one of said correlation measures at time
9 instant n , and $A_m(N)$ denotes one of said accumulation values
10 at index m .

1 10. The method as recited in claim 9 wherein said
2 determining step declares the presence of direct sequence
3 spread spectrum signals if the following condition can hold
4 true:

5
$$\frac{\max_m\{A_m(N)\}}{E_r(N)} > \frac{1}{\rho}$$

6 where $\max_m\{A(N)\}$ denotes the maximum of said accumulation
7 sequence, $E_r(N)$ denotes said statistic of said sample
8 sequence, and ρ is said predetermined threshold.

1 11. The method as recited in claim 9 wherein said
2 determining step declares the presence of direct sequence
3 spread spectrum signals if the following condition can hold
4 true:

5
$$\frac{\max_m\{A_m(N)\}}{E_r(N)} > \frac{1}{\rho}, \quad N = N_1, N_1 + 1, \dots, N_2$$

6 where $N_2 > N_1$, N_1 and N_2 are positive integers, $\max_m\{A(N)\}$
7 denotes the maximum of said accumulation sequence, $E_r(N)$
8 denotes said statistic of said sample sequence, and ρ is
9 said predetermined threshold.

1 12. The method as recited in claim 8 wherein said
2 statistic of said sample sequence is evaluated over $(N-1)$
3 times L number of samples of said sample sequence.

1 13. The method as recited in claim 12 wherein said
2 statistic of said sample sequence, $E_r(N)$, is given by:

3
$$E_r(N) = \sum_{n=0}^{(N-1)L-1} |r(n)|^2$$

4 where n denotes a time instant and $r(n)$ denotes a sample of
5 said sample sequence $\{r(n)\}$ at time instant n .

1 14. The method as recited in claim 12 wherein said
2 statistic of said sample sequence, $E_r(N)$, can be
3 approximated by the following equation:

4
$$E_r(N) = \sum_{n=0}^{(N-1) \cdot L-1} r(n)$$

5 where n denotes a time instant and $r(n)$ denotes a sample of
6 said sample sequence $\{r(n)\}$ at time instant n .

1 15. A method for detection of direct sequence spread
2 spectrum signals in networking systems, comprising the steps
3 of:

4 taking a sample sequence from a preamble of a newly
5 arrived network packet;
6 calculating a sequence of correlation measures between
7 said sample sequence and a pseudo-noise code
8 sequence of length L , where L is a positive
9 integer;
10 calculating an accumulation sequence, $\{A_m(N)\}$, from said
11 sequence of correlation measures, $\{C(n)\}$, as
12 follows:

13
$$A_m(N) = \sum_{k=0}^{N-1} C(m + k \cdot L), \quad m = 0, 1, 2, \dots, L-1$$

14 where

15 n denotes a time instant,
16 m denotes an integer index,
17 $C(n)$ denotes a correlation measure of said
18 sequence $\{C(n)\}$ at time instant n ,
19 $A_m(N)$ denotes an accumulation value of said
20 sequence $\{A_m(N)\}$ at index m , and
21 N is a predetermined integer number;

22 evaluating a statistic of said sample sequence over a
23 multiple of L number of samples;
24 normalizing the maximum of said accumulation sequence
25 with respect to said statistic of said sample
26 sequence; and
27 determining the presence of direct sequence spread
28 spectrum signals based on a comparison between a
29 predetermined threshold and said normalized
30 maximum of said accumulation sequence.

1 16. The method as recited in claim 15 wherein said
2 normalized maximum of said accumulation sequence, $NLA_{\max}(N)$,
3 is obtained by:

4
$$NLA_{\max}(N) = \frac{\max_m\{A_m(N)\}}{E_r(N)}$$

5 where $\max_m\{A_m(N)\}$ denotes the maximum of said accumulation
6 sequence and $E_r(N)$ denotes said statistic of said sample
7 sequence.

1 17. The method as recited in claim 16 wherein said
2 determining step declares the presence of direct sequence
3 spread spectrum signals if the following condition can hold
4 true:

5
$$NLA_{\max}(N) > \frac{1}{\rho}, \quad N = N_1, N_1 + 1, \dots, N_2$$

6 where ρ is said predetermined threshold, $N_2 > N_1$, N_1 and N_2
7 are positive integers.

1 18. The method as recited in claim 15 wherein said
2 statistic of said sample sequence is evaluated over $(N-1)$
3 times L number of samples of said sample sequence.

1 19. The method as recited in claim 18 wherein said
2 statistic of said sample sequence, $E_r(N)$, is given by:

3
$$E_r(N) = \sum_{n=0}^{(N-1)L-1} |r(n)|^2$$

4 where $r(n)$ denotes a sample of said sample sequence $\{r(n)\}$ at
5 time instant n .

1 20. The method as recited in claim 18 wherein said
2 statistic of said sample sequence, $E_r(N)$, can be
3 approximated by the following equation:

4
$$E_r(N) = \sum_{n=0}^{(N-1)L-1} |r(n)|$$

5 where n denotes a time instant and $r(n)$ denotes a sample of
6 said sample sequence $\{r(n)\}$ at time instant n .